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## SELECTION IN HEVEA.

The present condition of the rubber-market appears to be of the nature of a small boom in low-priced shares. The reason for this seems apparent and attributable to the present increased demand for the commodity. It seems however equally apparent, that the extent of the rise in price is limited by the very nature of this demand and we see it stated on all sides, that the conditions obtaining at present are likely to remain for some time.

The plantation industry as a whole developed at break-neck speed and the period of the boom was one which had the effect of an exhausting tonic, in that it whipped up certain aspects of the industry—notably that of planting: yet, it lowered the general tone of the plantations as a whole, in that it dictated a speed which made proper planting impossible, which clearly outpaced the speed at which science could apply itself, resulting in a general average far below that which might have been obtained had the industry been developed more slowly.

The phase of slower development is now however obtaining and showing its good effects: the industry has to some extent settled down and science is quickly picking up the leeway with the result that empiricism is giving way to its dictates every day. The boom period as is the case with all phases of similar nature in young industries, completely mystified all but the most conservative operator,—yet to-day it is the rare individual who does not look upon his plantation as unspent capital requiring very careful manipulation.

A result of this shaking down is that one of the first considerations of scientific planting, seed selection and stock questions generally, is after much delay years receiving attention, and everywhere we hear, as in every new book on rubber do we read of the great value of "seed selection" in providing the source for future planting.

Now it will be frankly acknowledged by many in the industry that "seed selection" as applied to the rubber industry is at present a mere phrase, the precision of whose meaning requires very careful indication. To some it is the panacea to all matters of the plantation, to others it is a magic, and that, because of its incomprehensibility. Let us for a moment consider its real interpretation.

The two proverbs "like begets like" and "nature never uses the same mould twice" appear at first sight very antithetic; they are both equally true as they are equally false, and they embody in general terms the scientific basis on which "Selection" in its proper sense may be carried out, the latter implying "variability" amongst individuals of the same class, the former implying the handing down of characters from generation to generation—that is "heredity."

Our plantations are full of individual trees all more or less alike yet varying in various characters such as colour of bark, shape of leaf, size of seed, nature of branching and, so it is said, in quantity and quality of latex procurable under equal conditions etc. It may be safely assumed that some or all of these varying characters are subject to the laws of heredity—the mode concerns us not—and this being so the term "Seed selection" has real practical significance. Now the planter with as is natural, direct his attention pirimarily to matters affecting his revenue, and it is for that reason that the question of "selection" has been looked upon almost solely from the point of view of possible increase in quantity of latex procurable. There is however another aspect to this very matter and that is "quality." The very term will perhaps raise doubts and perplexities in the minds of planters, it may do so even in the minds of brokers—so confused is our knowledge of it, yet those who who have read the Rubber-Recueil 1914 will see that it receives careful consideration from the scientific aspect at the hands of Dr. P. G. S. Cramer who raises the question anew and cites observations on the improbability of our original source of plantation rubber—the trees whence Wickham obtained our seed—being the producers of rubber of the best quality. The significance of the matter is obvious to all concerned though it must be confessed that it has been discussed many times before, and it may still be of interest to follow Cramer's line of argument fairly closely since the aspect of the problem is of scientific nature.

Cramer emphasizes at the out-set the difference between mere "picking out" of what appear to the observation as bad seed, and "Seed selection" proper. We know ourselves that much of the "especially selected" seed of the boom, or, for the matter of that of

the present period, had and has no positive virtues of quality in so far as this may be interpreted to mean producers of trees of above average nature. The nomenclature applied to them was and is but an allurement to the uninformed—a means of getting a high market price, and in no way carrying with it that fundamental necessity—knowledge of the parents which bore them.

As mentioned previously the possibility of proper selection depends on the variability of the material from which selection is to be made, together with the accompanying distribution by heredity. As concerns these two matters, and as regarding the wild stock whence we obtained our seed, Cramer raises the three fold query. Are all the wild trees uniform or variable, have the value of the various types been examined from the point of view of their practical use, and has the latter consideration in any way dictated the mode of selection?

As regards the variability of the wild stock there can be little doubt: there would in any case be a high degree of probability that such would be the case and evidence is cited which shews that the wild stock shows variability in characters such as we have noted above for our plantation trees, it being particularly striking in the case of the seed. Here it is shewn that the differences in shape and size of the seeds of two wild trees of Hevea braziliensis are so great as to exceed the differences in these characters, between seeds of two different species of Hevea.

Furthermore it is shown that these differences are associated with definite characters of seedlings raised from them. There is in fact much evidence to show that the wild stock is a very variable "population", one with great possibilities for the "selector." But how far does this hold regarding questions of quality; to what extent is this an attribute amenable to scientific selection? It is to the history of the plantation industry that Cramer looks for his evidence and definitely concludes that—

"The Tapajoz region (whence Wickham obtained his seed) is not the place where the best rubber comes from."

Further "the district where Wickham reports to have gathered his seeds furnishes at present a rubber of inferior quality"—this latter on the authority of Huber.

Now if this be actually so, and other things such as quantity being equal, it be possible to get the stock of higher quality, then it is clear that we are only making the best of a second rate thing in selecting from our plantation sources and we might be better advised in getting once again to the wild stock; but, be it noted in dealing with quality,—and with quality as indicated by market prices, for such are Cramer's criteria—comparative prices being quoted for

Tapajoz and Ihlas rubbers for January 1911—we are dealing with matters elastic in more ways than one, and the possibility of accuracy becomes reduced to almost a minimum. Further, even were market-price a criterion of quality the possibility seems to have been overlooked that the price of the rubber obtained from the trees whence Wickham got his seeds possibly was at the time of his gathering them, as high as that from any other source.

There is of course little doubt that "Quality" will be proved to be a variant even when science will have becomes so attuned to level up all possible fluctuation due to external treatment, but at present our real evidence is as flimsy as our method is crude. Nevertheless we await Dr. Cramer's results with great interest.

The other side of the question will be then perhaps our more immediate concern though it must be confessed that as soon as we have set our house in order as regard method, this question of latex quality, as understood to be determined by the individuality of the tree, will have possibilities.

Now in dealing with quantity we are again on treacherous ground, yet it will probably be agreed that it can be measured with some approach to precision if proper precautions are taken. On all sides we hear "Choose your seed for planting up from old heavy yielders." This maxim granted equal conditions in its sphere of application conveys the guiding principles to the extent at which they may be dictated at present. Let us consider the theoretical aspect of the question. The development of any organism depends on two sets of factors, the one the innate and inborn, the other the external, bound up by nutrition: at any moment in the life of an organism its degree of development represents as it were the resultant between these two sets of factors. How difficult it often is to distinguish their relative effects we are well aware. Their distinct nature can however be early shewn by example. We know for instance of tall plants developing to their full on good land, producing poor stunted growths year after year on poor land—reproducing poor stunted growths year after year on poor land, re-the originals when given back their requisite conditions for growing. It is their nature to be tall—they were "born" to be so. We can perhaps understand the attitude of mind of the thin individual of quite normal health who considers "dame nature" unkind in her disposition of tissue as he perforce must shiver in the cold while his more widely proportioned neighbour enjoys comfort. It is his nature to be thin; good feeding cannot totally override it though it can to some extent alter it for his generation. So it is with the rubber tree. It at all stages of development re-

presents the resultant of these two sets of factors. Of the nature of the former we are oblivious. Our reference to them as natural implies our ignorance, nevertheless it is on these that the whole question of selection depends.

Let us see what conditions are necessary before we can prove the extent of even the existence of this inherent fluctuation in quantity. It may be safely assumed that the conditions obtaining in this country are such as permit the full development of the Rubber tree. The planter knows full well when his trees are doing well, and there are few who would be rash enough to say that best possible plantation conditions of this country do not approach the ideal. This being so we can give fullest opportunity for the natural possibilities of the tree to develop. But where are we to begin on this question of proof of "quantity variation" inherent in the same. Shall we plant anew with this our primary object in view and revenue a secondary consideration, or, shall we take our present stock and with what knowledge we have of its history as to tapping attempt the obtaining of comparable information. Against this latter there is the difficulty of which we are all well aware—the inadequacy of our records—and with this comes the important consideration that we as yet know next to nothing of the nature of latex exudation in response to wounding, for be it remembered that we exploit tissue of the tree by a series of cuts whose real effect—though at present it certainly seems a transient one—is unknown. There is a pressing and immediate need for attention to be paid to a detailed study of the Physiology of the tree: we know of the prodigious yields of trees affected by white ants, we hear the extraordinary behest to use seed of untapped trees for seed purposes —our knowledge is arrestingly scanty.

It may seem the more scientific plan to plant afresh—and possibly from a new collection of seeds from Brazil. Yet if this is so we lose some forty years. Can this be worth it? And are we in the meantime to adopt no special plan for immediate plantings. As a matter of fact it seems neither worth it or necessary except from the point of view of pure science. Let us take our material—we have a wide choice: let us apply ourselves to obtaining precision in our method, avoiding the absolutely unpermittable range of experimental errors common in almost all tapping investigations up to the present day: let our first consideration be data worthy of the name: let us get reliable figures from very many trees spread over a wide area, with all external conditions known and as nearly as possible equalized. The way is as clear as it will be tedious, there are no short cuts. Let us not delude ourselves into

thinking that the matter is one of but a few years' investigation and having avoided this delusion, let us not relegate the matter to the pigeon hole because of it being of no immediate economic significance, because it can but be a heritage for others.

The ideal seems to be one of international cooperative effort. This should not be difficult to establish and, being established, certainly not difficulty to work.

G. E. C.

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## VULCANISATION EXPERIMENTS ON PLANTATION RUBBER. II.

By B. J. Eaton and J. Grantham.

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### Experiment VI.

This experiment illustrates the effect of each stage in the preparation of thin crepe in lengthening the optimum time of cure in the finished rubber. The samples were prepared on an estate normally turning out thin pale crepe, and each represents a stage in the ordinary process adopted by the estate.

The samples were:—

A. The coagulated slab allowed to drain.
B. The coagulum rolled once.
C. Rough Crepe.
D. Thick Crepe.
E. Thin Crepe.

The samples were kept for 20 days and then A. B. and C. were made into thin crepe and dried preparatory to mixing. (Note Samples D. and E. were dried without subsequent crepeing. All the samples contained sodium bisulphite.) Each was vulcanised for eight or nine different times.

An examination of the load-stretch curves in every case showed that the rate of cure decreased continuously from A to E. The optimum times of cure as determined from the curves *i.e.* times at which the samples gave curves agreeing with the "optimum curve" were as follows:—

Optimum time of cure shown by the load-stretch curves.

| | | |
|---|---|---|
| A. | .. .. | $1\frac{1}{2}$ hours. |
| B. | .. .. | 2 „ |
| C. | .. .. | $2\frac{1}{2}$ „ |
| D. | .. .. | $2\frac{3}{4}$ „ |
| E. | .. .. | 3 „ |

The times at which the numerical results indicated optima (*i.e.* when the product "breaking load x stretch" was a maximum) were as follows:

| No | Breaking load Kgs. per sq. mm (a) | Extension at Break. (Orig. length=100) (b) | Product. (axb) | Optimum time of cure. hours. |
|---|---|---|---|---|
| 78 A. | 1.44 | 1036 | 1492 | 1½ |
| B. | 1.55 | 982 | 1522 | 2¼ |
| C. | 1.36 | 961 | 1307 | 3 |
| *D. | 1.36 | 922 | 1254 | 3½ |
| E. | Sample exhausted before a maximum was obtained. | | | |

*A higher figure might have been obtained at 3¼ hours but no cure was made owing to the sample becoming exhausted.

In the above optimum the same order is shown in the rate of cure as by the curves, though the actual times calculated by the two methods differ.

The difference in rate of cure is also well shown if the figures for each sample cured at any particular time are examined, as shown below, in which the figures for a cure of 2½ hours are given.

*Time of cure 2½ hours.*

| | Breaking Load Kgs per sq. mm. | Elongation at Break. orig. length=100 | Product. axb |
|---|---|---|---|
| A. | .16 | 414 | 66 |
| B. | 1.26 | 890 | 1121 |
| C. | 1.18 | 1010 | 1192 |
| D. | .98 | 1014 | 994 |
| E. | .98 | 1044 | 1023 |

The state of cure is here very well seen in the extension figures, sample E being clearly undercured with a very high extension and sample A very much undercured with a low extension. No sample gives its optimum physical properties at this time, B and C are the nearest to their optimum, B being slightly overcured and C undercured.

## UNIFORMITY.

### Experiment VII.

In order to ascertain how far uniformity is possible under ordinary estate conditions, samples of 10 days' rubbers were obtained from Castleton Estate, Telok Anson. These samples were taken from the crepe prepared from bulked latex ordinarily turned out by the estate and were not specially prepared for the experiment. No special precautions were therefore made in their preparation. The latex was bulked in a large tank and coagulated by the addition of 3 ozs of 5% acetic acid per gallon of latex or approximately 1 part

of 5 per cent acid to 50 parts of latex. The rubber was creped the same day, an hour or two after coagulation. It was found necessary at this time to add a small quantity of formalin to the latex in order to prevent spotting, and some of these samples contain this chemical, as seen below. The resulting thin crepe was of a golden colour, and fetched top prices at Singapore.

The following is a list of the samples:—

| No. | Date. | Rainfall preceding 24 hours inches. | Remarks. |
|---|---|---|---|
| A. | April 28 | .22 | No formalin. |
| | (April 29 | 1.27 | (No tapping) |
| C. | April 30 | .01 | Formalin added. |
| D. | May 1 | nil | do. |
| E. | 2 | 1.10 | do. (late tapping) |
| F. | 3 | nil | do. do. |
| G. | 4 | .22 | do. do. |
| H. | 5 | nil | do. do. |
| K. | 6 | .09 | do. do. |
| L. | 7 | .35 | No formalin. |
| M. | 8 | nil | Formalin added. |

Each sample was vulcanised at $\frac{1}{4}$ hour intervals from $2\frac{1}{4}$ to $3\frac{3}{4}$ hours. The optimum results are given below:—

| No. | Breaking Load Kgs per sq. mm. (*a*) | Elongation at break orig. length=100. (*b*) | Product a x b. | Time of cure Hours. |
|---|---|---|---|---|
| 74 A. (No formalin) | 1.30 | 924 | 1201 | $3\frac{1}{2}$ |
| C. | 1.36 | 969 | 1318 | $3\frac{1}{2}$ |
| D. | 1.19 | 963 | 1146 | $3\frac{1}{4}$ |
| E. | 1.36 | 940 | 1278 | $3\frac{1}{2}$ |
| F. | 1.35 | 925 | 1249 | $3\frac{3}{4}$ |
| G. | 1.18 | 998 | 1177 | $3\frac{1}{4}$ |
| H. | 1.30 | 908 | 1180 | $3\frac{3}{4}$ |
| K. | 1.20 | 987 | 1184 | $3\frac{1}{4}$ |
| L. (No formalin) | 1.32 | 941 | 1242 | $3\frac{1}{2}$ |
| M. | 1.14 | 972 | 1108 | $3\frac{1}{4}$ |

These figures give little indication of any difference between the formalin and non-formalin samples.

The variations shown in the table are:—

| | | | | | | |
|---|---|---|---|---|---|---|
| Load | 1.14-1.36 kgs. per sq. mm. | or a range of variation of | 19% | from the minimum. | | |
| Elong | 908-983 | per cent | or | ,, | ,, | 10% ,, ,, |
| Product | 1317-1107 | | or | ,, | ,, | 16% ,, ,, |
| Time of cure | $3\frac{1}{4}$-$3\frac{3}{4}$ | | or | ,, | ,, | 15% ,, ,, |

It is interesting to note that the two samples C and E giving the greatest load 1.36 kgs. per mm. and also the two greatest products

1317 and 1278 respectively were both tapped after heavy rainfall. In the case of C, rain on the previous day had prevented tapping and in the case of E, rain caused late tapping. This may or may not be a coincidence, and requires further investigation.

An examination of the load-stretch curves showed that C, D, F, G, H, K, L and M were practically identical in mechanical properties at points below the actual breaking point at each time of cure. Samples A and L, the rubbers which were prepared without formalin, gave two similar curves which differed slightly from those of C, D, F, G, H, K, L and M and indicated a slightly slower rate of cure. E for some reason gave curves similar to those of A and L.

The optimum times of cure deduced from the curves together with the actual breaking point figures obtained at these times are as follows:—

| No. | Optimum time of cure deduced from the load-stretch curve. | Breaking Load (Kgs per sq. mm.) (*a*) | Elongation at break (Orig.length=100) (*b*) | Product. axb |
|---|---|---|---|---|
| 74 A. | (No formalin) 3 hours. | 1.13 | 958 | 1082 |
| L. | (No formalin) 3 „ | 1.11 | 958 | 1063 |
| E. | 3 „ | 1.17 | 970 | 1134 |
| C. | 3¼ „ | 1.13 | 971 | 1097 |
| D. | 3¼ „ | 1.19 | 963 | 1145 |
| F. | 3¼ „ | 1.12 | 982 | 1099 |
| G. | 3¼ „ | 1.18 | 998 | 1177 |
| H. | 3¼ „ | 1.13 | 975 | 1124 |
| K. | 3¼ „ | 1.20 | 987 | 1184 |
| M. | 3¼ „ | 1.14 | 972 | 1108 |

Leaving out A and L there are 8 samples prepared in an identical manner and all with one exception (viz. E. which was tapped late) have an optimum time of cure, calculated by this method of 3¼ hours.

The range of variation of mechanical properties is:—

| | | |
|---|---|---|
| Load | 1.12-1.20 Kgs. per sq. mm. | or a range of variation from 7% on the minimum |
| Elongation | 963-998 per cent | „ „ „ „ 3.6% „ |
| Product | 1097-1184 „ | „ „ „ „ 8% „ |

The superiority of this method (by which the properties of the rubber are deduced by a consideration of the load-stretch curves showing the elongation and load at every point from start to breaking point) over the method, by which they are deduced from the actual breaking point figures only, is well shown here.

The "accidental" nature of the breaking point tends to show differences between rubbers which do not really exist.

The rubbers C, D, F, G, H, K and M, which were prepared

under uniform conditions (E is excluded owing to the late tapping) are as uniform as can possibly be expected. They all cure at the same time, and give rubber possessing identical properties below the breaking point and the maximum variation of the actual breaking point figures is only 8%. A manufacturer receiving these seven batches of rubber from which these samples were taken could test a sample from one of them, base all his vulcanisations on this test, and there would be no variation except one of 8% on breaking point figures which can never be kept absolutely constant, the difference in this figure being, within certain limits, due entirely to experimental error. By keeping the particular conditions which are used on Castelton Estate constant and, within the limits of time here taken, it is then possible to produce a uniform rubber, but the conditions must be kept rigid even as to the tapping. There are however two factors which militate against this method of production of uniform rubber:—

(1). The time of cure is long, since the method of preparation, *i.e.* conversion into crepe on the day of coagulation, produces only the minimum amount of accelerating agent in the finished rubber. This probably accounts for the uniformity of time of cure.

(2). The average maximum mechanical properties appear to have suffered slightly. This may be due to the machining of the very soft coagulum, or possibly a secondary result of (1), the lengthened heating during vulcanisation causing a slight deterioration.

Whether uniformity is attainable under other factory conditions and those which would obviate these disadvantages, remains to be seen.

## SUMMARY.

(1). It is shown that the effect of each stage in the preparation of a thin crepe, is to retard the rate of cure. This effect must not be confused with the results given in the previous paper (vide Agricultural Bulletin Vol. III, Nos. 6-7, page 225, March-April) in which it was shown that the passing of thin crepe a number of times through a crepeing machine (*i.e.* additional crepeing beyond that necessary first to produce the thin crepe) had little or no effect.

(2). That when the retardation of the rate of vulcanisation reaches a limit, as in the preparation of thin crepe machined on the day of coagulation, a very uniform rubber is obtained, although the rate of cure, as shown, is very slow, and the mechanical properties suffer slightly.

## CAMPHOR AND CAMPHOR OIL.

In connection with experiments on the preparation of camphor from the Japanese camphor tree (*Cinnamomum camphora*) the results of which were published in Bulletin No. 15, Department of Agriculture, F. M. S., specimens of the camphor oil separated by decantation and expression from the crude camphor, were sent to the Imperial Institute, London, for further investigation and valuation. Preliminary and detailed reports have now been received and the results and conclusions of these investigations are contained in the following report.

It was anticipated that the samples sent at different times would be very similar, as they were distilled from similar material and would vary chiefly in camphor content. This is borne out by the results obtained.

### Chemical Examination.

The following results were obtained on chemical examination:—

| | 1st Sample of Oil. | 2nd Sample of oil. |
|---|---|---|
| Specific Gravity at 15°C/15°C ... | 0.913 | 0.920 |
| Optical Rotation in 100 mm. tube. | +1°.1′ at 18°C | 38°.23′ at 22°C |
| Camphor content on cooling to —10°C to—12°C .. .. | 19.3 per cent. | 12.8 per cent. |
| Acid value. .. .. .. .. | — | 1.1 |
| Saponification (Original Oil) .. | | 3.6 (=0.7 per cent esters) |
| Saponification after acetylation ... | | 25.7 (=6.1 per cent alcohols) |

The physical constants given above were obtained on the oil, after removal of the campor by cooling.

In both cases the oil is described as a pale yellow oil, containing a considerable quantity of crystalline deposit and possessing a camphoraceous odour.

Although the oil was filtered and contained no crystalline deposit on leaving here, the crystallisation of a part of the camplior contained in it, would naturally occur on reaching a cooler climate.

Further prolonged cooling of the second sample yielded a total camphor content of 14.2 per cent.

The principal difference in the two samples was therefore in the camphor content.

The second sample of oil was fractionally distilled and yielded the following results;—

| Fraction. | Boiling Points. | Percent by Volume. |
|---|---|---|
| 1. | 150°-195°C | 40 |
| 2. | 195°-225°C | 46 |
| 3. | 225°-275°C | 14 |

Fraction 1 was found to contain cineole amounting to 4.3 per cent on the original oil, and this accounts for the greater portion of the alcohols. By cooling fraction 2 to-12°C a further quantity of camphor separated; a total yield of 15.7 per cent by weight of camphor, calculated on the original oil, was obtained, so that the total camphor content of this second sample of oil was 30.5 per cent viz. 14.8 per cent by cooling the original oil and 15.7 per cent by cooling fraction 2 of the residual oil.

Safrole:—An interesting feature of both samples is the absence of safrole to which constituent the Japanese oil owes its commercial value. As stated in the report from the Imperial Institute, it is probable that the absence of safrole is due to the fact that the distillate is obtained from young twigs and leaves, whereas in the ordinary Japanese camphor oil of commerce, the distillate is derived from old wood from mature trees.

In the report from the Imperial Istitute, it is stated that according to the publication "Der Planzer" (Vol. II 1906 page 333) a specimen of camphor oil distilled from leaves and twigs in German East Africa, also contained no safrole.

### Commercial Valuation.

First sample:—The original sample was valued in 1912 by English and German experts. The English commercial expert states that it was difficult to value the oil, but if free from camphor it should be worth 7½ to 8*d* per lb. in London (N.B. The presence of camphor would probably enhance rather than decrease its value, as camphor is more valuable than the oil and its separation from the oil is comparatively simple).

The German firm stated that they were unable to assign a definite value, as they do not use camphor oils free from safrole, but they considered it might be worth 30/- per cwt. in Europe, this valuation being less than one-half the English expert valuation.

Japanese camphor oil is practically free from camphor, as all the camphor is extracted before shipment and its value depends on its safrole content.

Second sample:—Samples of the oil and of the distillates obtained by fractional distillation were submitted to a firm of essential oil distillers for an opinion as to its value and the opinion was expressed that the oil should command about the same price as ordinary brown Japanese oil, the absence of safrole being compensated by the amount of camphor present. The price of Japanese

brown camphor oil (March 1915) in London was £45 per ton, or slightly over $4\frac{3}{4}d$ per lb. During the last five years the price has fluctuated from £45 to £80 per ton.

### Crude Camphor.

A sample of the crude crystalline camphor separated in the condenser from the oil, as much as possible of the oil being separated subsequently in a hand press, was also forwarded at the same time to the Imperial Institute for valuation.

On submitting to further pressure in England to remove moisture and oil, the crude camphor lost 11 to 12 per cent of its weight, indicating 88 to 89 per cent of camphor. This is stated to compare favourably with the percentage contained in crude Japanese and Formosan camphor.

The following physical constants were obtained:—

| | |
|---|---|
| Crude camphor .. .. .. .. | +40°-50′ |
| Crude camphor after pressing .. .. | +42°-20′ |
| Camphor recrystallised from benzine .. | +41°-25′ |
| Camphor separated from oil .. .. | +42°-20′ |

These figures agree fairly well with those usually recorded for refined camphor which vary between 41° and 40°.

### Valuation.

The crude camphor was submitted to a firm of commercial experts who reported that it appeared to be very similar to Chinese "leaf" camphor, which is occasionally put on the market in small quantities, and valued the material at £6 to £6. 5*s.* per cwt. with the better quality of Japanese Monopoly B. Camphor at £7. 2*s.* 6*d.* per cwt.

Remarks:—The crude camphor would, according to the report from the Imperial Institute, be readily saleable in London.

The suggestion that the camphor present in the oil should be separated before export, is not very feasible, as it would probably be more advisable to carry this out in a colder climate. The large content of camphor in the oil is obviously due principally to the fact that the normal temperature of the oil in this country is about 28° to 30°C. at which temperature it absorbs a comparatively large quantity of camphor.

B. J. E.

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## SOIL ANALYSIS AS A GUIDE TO MANURING.

By J. Grantham.

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As practically all our present knowledge regarding soil fertility has been gained by a study of soils in the temperate zone, it is

necessary to consider the modifications needed to apply this knowledge to the special conditions of the tropics. Here I propose to deal particularly with rubber soils of Malaya.

It has now for a long time been recognised that chemical analysis of soil alone is of little use and gives misleading results. It is essential that the texture of the soil as indicated by the mechanical analysis should also be known. Our present method of mechanical analysis though the best practical one, is imperfect owing to its inability to indicate the state of aggregation of the particles of the soil, and this aggregation modifies the texture. It is however possible by mechanical analyses to divide soil into certain types within which, useful results can be obtained from chemical analysis, always subject to the limitations of climate and drainage conditions. In two cases viz. calcareous and peaty soils the mechanical analysis is of no value, the calcium carbonate and peat respectively being the dominating factors. In general it is only necessary in the chemical analysis to determine the nitrogen, phosphate, potash and calcium carbonate (or acidity) in the soil and it has been recognised that the total potash and phosphate are of less value in determining the fertility of the soil than the available potash and phosphate (viz. that proportion of these substances soluble in the sap of the root hairs). Also there is the "law of the minimum" which states that if the growth of a crop is limited by any one factor, an excess of any other factor is without effect. Finally in recent years it has been shown that the fertility of the soil is profoundly influenced by its bacterial flora. The practical application of this knowledge is however as yet in its infancy.

The result which can be achieved at present by soil analysis is this, given the requirement of the particular crop, the climatic and drainage conditions, it is possible in many cases to indicate the requirements of the soil by combined mechanical and chemical analysis. It must be remembered however that this is only rendered possible by the accumulation of experimental data from all types of soil under differing conditions. Even then it is not possible in all cases, and our imperfect knowledge of the bacteriology of the soil is no doubt often responsible.

Such then, are the guiding principles of soil analysis gained from experience in temperate climates. The particular conditions of Malaya greatly modify the relative importance of these principles. The rubber soils of Malaya are sharply divided into two classes, the hill land and the flat land the latter being subdivided into non-peaty and peaty. Over a range of wide variations of mechanical compositions the soils in each of these classes retain the characteristic

of the class. Mechanical composition is relatively of much less importance. Hill lands in general are very poor in nitrogen, potash and phosphate, and the flat coast lands relatively rich, the peaty soils being the richest. In spite of this, yields from hill soils are often higher than from the coast soils, the yields from which drop off after the first few years. As regards any conclusions drawn from soil analysis it is evident that the two types must be kept absolutely distinct. Further subdivisions within these types is however necessary if a relation between soil composition and yield is to be obtained with any constancy. The very low percentage of nitrogen, potash, and phosphate in hill soils is probably due to the uniform high temperature and rainfall which hastens decomposition of the soil and results in washing out of these substances. High yields are however possible on extremely small percentages of nitrogen, potash and phosphate. This is possible since rubber removes from the soil only about 8 to 10% of the quantity removed by temperate crops such as wheat. The exact minimum amounts required for rubber are not yet definitely known though they are certainly very low. Also in the opinion of the writer, with a permanent crop like rubber and in a country like this where decomposition is rapid, the determination of the total potash and phosphate is of more importance than the available.

All Malayan soils are more or less acid, and therefore contain no calcium carbonate, but require a determination of the lime requirement (viz. acidity). There is no general relation between the acidity of a soil and the yield given by it, but it is probable again that this may be found to be the case within restricted types of soil. As regards the bacterial conditions of Malayan rubber soils nothing is known at present.

We have then so far neither sufficient experimental data to have acquired that knowledge of the requirements of each different type of soil which is essential to the accurate interpretation of analytical results nor do we know definitely the requirements of of the rubber tree. Time is necessary for the accumulation of the required facts. The manurial experiments being conducted by the Department and the analyses of estate soil samples which are being carried out are gradually providing much useful material.

In connection with the estate samples, cases are constantly occurring where the yield is falling off, and application is made for an analysis of the soil and advice as regards manuring. In many cases the falling off in yield is due to causes which manuring will not remedy. Amongst the most common are close planting and over tapping. In some cases the drainage is at fault; particularly is

this the case in some very peaty soils in which it is a very difficult and expensive matter to lower the waterlevel sufficiently far below the surface and consequently after reaching a certain age the trees cease to grow owing to lack of root development. Another frequent cause of infertility is the opening up of steep hill land without taking precautions to prevent wash. The gain due to clean weeding on land of this type is lost if the whole surface soil is washed away. Terracing, the planting of a cover crop, or even leaving narrow strips of weeds to cause the formation of natural terraces will pay in the end.

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## CATALOGUE OF PLANT NAMES.

(*Continued*).

*Contained in the Public Gardens, Kuala Lumpur, Federated Malay States.*

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By J. N. Milsum.

### MONOCOTYLEDONS

ORCHIDEÆ.

Aerides, Lour.

Aerides sp. Epiphyte.

Angraecum, Thou.

Angraecum sesquipedale, *Thou.* Epiphyte, Madagascar.

Arundina, Bl.

Arundina bambusæfolia, *Lindl.* Terrestial, Malaya.

Bromheadia, Lindl.

Bromheadia palustris, *Lindl.* Terrestial, Malaya.

Calanthe, R. Br.

Calanthe rubens, *Ridl.* Terrestial, Malaya.

Cattleya, Lindl.

Cattleya labiata, *Lindl.* Epiphyte, Brazil.

Cirrhopetalum, Lindl.

Cirrhopetalum sp. Epiphyte, Malaya.

Coelogyne, Lindl.

Coelogyne asperata, *Lindl.* Epiphyte, Malaya.

Coelogyne pandurata, *Lindl.* Epiphyte, Malaya.

Coelogyne odoratissima, *Lindl.* Epiphyte, India and Ceylon.

Cymbidium, Sw.

Cymbidium sp. Epiphyte, Malaya.

Cypripedium, L.

Cypripedium niveum, *Rchb. f.* Terrestial, Malaya.

Dendrobium, Sw.

Dendrobium species. Epiphyte, Malaya.

Eria, Lindl.

Eria species. Epiphyte, Malaya.

Grammatophyllum, Bl.

Grammatophyllum speciosum, *Bl.* Epiphyte, Malaya.

Habenaria, Willd.

Habenaria sp. Terrestial, Malaya.

Phaius, Lour.

Phaius callosus, *Lindl.* Terrestial, Malaya.

Phalænopsis, Bl.

Palænopsis cornu-cervi, *Rchb. f.* Epiphyte, Malaya.

Phalænopsis violacea, *Teysm.* Epiphyte, Malaya.

Renanthera, Lour.

Renanthera coccinea, *Lour.* Epiphyte, China.

Saccolabium, Bl.

Saccolabium sp. Epiphyte, Malaya.

Spathoglottis, Bl.

Spathoglottis plicata, *Bl.* Terrestial, Malaya.

Spathoglottis plicata var alba. Terrestial, Malaya.

Vanda, R. Br.

Vanda Hookeriana, *Rchb. f.* Epiphyte or terrestial, Malaya.

Vanda teres, *Lindl.* Epiphyte or terrestial, E. Indies and Burma.

Vanda teres var Joaquim.

Vanilla, Sw.

Vanilla Pompona, *Schiede.* Cl. shrub, Spice, T. America. *Vanilla.*

## SCITAMINEÆ.

Alpinia, L.

Alpinia species. Herbaceous, Malaya.

Calathea, Mey.

Calathea sp. Foliage Plant, Ornament, Malaya.

Canna, L.

Canna edulis, *Ker.* P. Herb, Edible Tubers, W. Indies. *Queensland Arrowroot.*

Canna indica, *Rosc.* P. Herb, Ornament, W. Indies. *and many garden varieties.*

Costus, L.

Costus speciosus, *Smith.* Fl. Shrub, Ornament, India and Malaya.

Hedychium, Koenig.

Hedychium coronarium, *Koenig.* Ornament, India & Malaya.
Hedychium coccineum var angustifolium. Ornament, India.

HELICONIA, L.

Heliconia rubra-striata. Fol. Plant, Ornament.
Heliconia metallica, *P. and L.* Fol. Plant, Ornament, Brazil.

MARANTA, Plum.

Maranta amabilis, *Linden.* Fol. Plant, Ornament, Brazil.
Maranta arundinacea, *L.* Edible Tubers, S. America.
*West Indian Arrowroot.*
Maranta arundinacea var variegata. Fol. plant, Ornament.
Maranta bicolor, *Ker.* Fol. plant, Ornament, Brazil.

MUSA, L.

Musa sapientum, *L.* Arborescent Herb, Edible Fruit, India.
*Plantain and local varieties.*

RAVENALA, Adams.

Ravenala madagascariensis, *Sonn.* Arborescent Herb, Ornament.
*Traveller's Palm.*

ZINGIBER, Adans.

Zingiber officinale, *Rosc.* Herbaceous, Edible Rhizomes, India.
*Ginger.*

## BROMELIACEÆ.

ANANAS, Adans.

Ananas sativus, *Lindl.* Herbaceous, Edible fruit, T. America.
*Pineapple.*
Ananas sativus var variegatus. Ornament.

PITCAIRNIA, L'Herit.

Pitcairnia sp. Fol. plant, Ornament, Brazil.

BILLBERGIA, Thunb.

Billbergia coccinea. Fol. plant, Ornament, S. America.

## HAEMODORACEÆ.

SANSEVIERIA, Thunb.

Sansevieria zeylanica, *Willd.* Herbaceous, Perenn, Fibre, T. Asia and Africa.
*Bowstring Hemp.*

## IRIDEÆ.

MORÆA, L.

Moraea sp. Bulbous Plant, Ornament.

## AMARYLLIDEÆ.

AGAVE, L.

Agave americana, *L.* Succulent Plants, Ornament, Trop. America.

Agave americana var variegata.

Agave ferox, *Koch*. Succulent Plant, Ornament, Mexico.

Agave rigida var sisalina, *Engelm*. Succulent Plant, Fibre, Mexico.

*Sisal Hemp*.

AMARYLLIS, L.

Amaryllis hybrids, Bulbous Plants, Ornament.

Amaryllis reticulata. Bulbous Plants, Ornament, Brazil.

CRINUM, L.

Crinum asisticum, *L*. Bulbous Plants, Ornament, T. Asia.

Crinum Moorei, *Hook. f*. Bulbous Plants, Ornament, S. Africa.

Crinum Powellii, *Hort*. Bulbous Plants, Ornament.

EUCHARIS, Planch.

Eucharis grandiflora, *Planch*. Bulbous Plant, Ornament, Colombia.

*Amazon Lily*.

FUCRÆA, Vent.

Fucræa gigantea, *Vent*. Succulent Plant, T. America.

HÆMANTHUS, L.

Hæmanthus Katherinæ, *Baker*. Bulbous Plant, Ornament, Natal.

HYMENOCALLIS, Salisb.

Hymenocallis sp. Bulbous Plant, Ornament.

ZEPHYRANTHES, Herb.

Zephyranthes candida, *Herb*. Bulbous Plant, Ornament, La Plata.

Zephyranthes rosea, *Lindl*. Bulbous Plant, Ornament, Cuba.

POLIANTHES, L.

Polianthes tuberosa, *L*. Bulbous Plant, Ornament, India.

*Tuberose*.

## TACCACEÆ.

TACCA, Forst.

Tacca cristata, *Jacq*. Ornament, Malaya.

## LILIACEÆ.

ALŒ, L.

Alœ sp. Succulent Plant, Ornament, S. Africa.

ASPARAGUS, L.

Asparagus plumosus, *Baker*. Fol. climber, Ornament, Natal.

Asparagus Sprengeri, *Regel*. Fol. climber, Ornament, Natal.

ASPIDISTRA, Gawl.

Aspidistra lurida, *Ker*. Fol. plant, Ornament, China.

CORDYLINE, Comm.

Cordyline terminalis, *Kunth*. Fol. plant, Ornament, Australia.

*Dracaena of Gardens.*

DRACÆNA, Vand.

Dracæna angustifolia, *Roxb.* Shrub, Ornament, Malaya.

Dracæna Godseffiana, *Baker.* Shrub, Ornament, W. T. Africa.

Dracæna Sanderiana, *Hort.* Shrub, Ornament, W. T. Africa.

GLORIOSA, L.

Gloriosa superba, *L.* Fl. climber, Ornament, Tropics.

Gloriosa virescens, *Lindl.* Fl. climber, Ornament, T. Africa.

SMILAX, L.

Smilax species. Climber, Ornament, Malaya.

YUCCA, Dill.

Yucca sp. Succulent Plant, Ornament, U. S. America.

PONTEDERIACÆ.

EICHORNEA, Kunth.

Eichornea crassipes, *Kunth.* Aquatic, Ornament, T. America.

COMMELINACEÆ.

ZEBRINA, Schnizl.

Zebrina pendula, *Schnizl.* Ornament, Mexico.

PALMÆ.

ARCHOTOPHŒNIX, W. and D.

Archontophœnix Alexandræ, *Wendl.* Queensland.

ARECA, L.

Areca catechu, *L.* Edible Seeds, T. Asia.

*Betel Nut.*

Areca triandra, *Roxb.* India.

ARENGA, Labill.

Arenga saccharifera, *Labill.* Sugar, Malaya.

*Kabong Palm.*

BORASSUS, L.

Borassus flabelliformis, *L.* Fibre, India and Africa.

*Palmyra.*

CALAMUS, L.

Calamus sp. Rotans, Malaya.

CARYOTA, L.

Caryota mitis, *Lour.* Malaya.

Caryota urens, *L.* Drug, T. Asia.

CHRYSALIDOCARPUS, Wendl.

Chrysalidocarpus lutescens, *Wendl.* Madagascar.

COCOS, L.

Cocos flexuosa, *Mart.* Brazil.

Cocos nucifera, *L.* Tropics.

*Coconut.*

Cocos plumosa, *Lodd.* Brazil.

CORYPHA, L.
Corypha umbraculifera, *L.* India.
*Talipot Palm.*
CYRTOSTACHYS, Bl.
Cyrtostachys Lakka, *Becc.* Malaya.
*Sealing Wax Palm.*
DÆMONOROPS, Bl.
Dæmonorops calicarpus, *Mart.* Malaya.
DIDYMOSPERMA, W. and D.
Didymosperma hastata, *Becc.* Malaya.
ELÆIS, Jacq.
Elæis guineensis, *Jacq.* Oil, Trop. Africa.
*African Oil Palm.*
EUTERPE, Gaertn.
Euterpe ventricosa.
HOWEA, Becc.
Howea Belmoreana, *Becc.* Lord Howe's Isls.
Howea Forsteriana, *Becc.* Lord Howe's Isls.
LANTANIA, Comm.
Lantania Commersoni, *L.* Mauritius.
LICUALA, Thunb.
Licuala grandis, *Wendl.* New Hebrides.
Licuala spinosa, *Griff.* Malaya.
LIVISTONIA, Br.
Livistonia australis, *Mart.* Australia.
Livistonia Chinensis, *Br.* China.
LOXOCOCCUS, Wand D.
Loxococcus rupicola, *Wendl.* Ceylon.
*Dotalu.*
MARTINEZIA, R. and P.
Martinezia caryotæfolia, *H. B. K.* Colombia.
MAXIMILIANA, Mart.
Maximiliana regia, *Mart.* Brazil.
ONCOSPERMA, Bl.
Oncosperma horrida, *Scheff.* Malaya.
*Bayas.*
OREODOXA, Willd.
Oreodoxa regia, *H. B. K.* Cuba and Panama.
*Royal Palm.*
PHOENIX, L.
Phoenix spinosa, *Thonn.* W. T. Africa.
PINANGA, Bl.
Pinanga sp. Malaya.
PTYCHOSPERMA, Labill.
Ptychosperma McArthuri, *Wendl.* Australia.

RAPHIS, L.

Raphis flabelliformis, *L'Herit.* China.

SABAL, Adans.

Sabal Blackburniana, *Glazebr.* S. U. States America.

Sabal palmetto, *Lodd.* S. U. States America.

STEVENSONIA, Duncan.

Stevensonia grandifolia, *Dunc.* Seychelles.

## PANDANEÆ.

PANDANUS, Linn. f.

Pandanus species. Fol. Plants, Ornament, Malaya.

FREYCINETIA, Gaud.

Freycinetia angustifolia, *Bl.* Fol. Plants, Ornament, Malaya.

## AROIDEÆ.

AGLAONEMA, Schott.

Aglaonema costatum, *N. E. Br.* Fol. Plants, Ornament, Perak.

Aglaonema commutatum, *Schott.* Fol. Plants, Ornament, Philippines.

Aglaonema marantifolium, *Blume.* Fol. Plants, Ornament, Malaya.

ALOCASIA, Schott.

Alocasia sp. Fol. plant, Ornament.

AMORPHOPHALLUS, Bl.

Amorphophallus sp. Tubers, Ornament, Malaya.

ANTHURIUM, Schott.

Anthurium Andreanum, *Linden.* Foliage Plants, Ornament, Colombia.

Anthurium Bakeri, *Hook. f.* Fol. plant, Ornament, C. America.

Anthurium cristatum, *Linden.* Fol. plant, Ornament, Peru.

Anthurium insigne, *Masters.* Fol. plant, Ornament, S. America.

Anthurium Wardianum. Fol. plant, Ornament, Colombia.

CALADIUM, Vent.

Caladium bicolor, *Vent.* Fol. plant, Ornament, S. America. *and garden varieties.*

DIEFFENBACHIA, Schott.

Dieffenbachia baraquiniana, *Lem.* Fol. plant, Ornament, Brazil.

Dieffenbachia Leopoldii, *Bull.* Fol. plant, Ornament, S. America.

Dieffenbachia Reginæ. Fol. plant, Ornament.

Dieffenbachia picta, *Schott.* Fol. plant, Ornament, Brazil.

Dieffenbachia seguine, *Schott.* Fol. plant, Ornament, T. America.

HOMALOMENA, Schott.

Homalomena angustifalia, *Hook. f.* Fol. plant, Ornament, Malaya.

Homalomena humilis, *Hook. f.* Fol. plant, Ornament, Penang.

Homalomena rostratum, *Griff.* Fol. plant, Ornament, Malaya.

MONSTERA, Adans.

Monstera deliciosa, *Liebm.* Climber, Edible fruit, Mexico.

PHILODENDRON, Schott.

Philodendron gloriosum, *Andre.* Ornament, Colombia.

XANTHOSOMA, Schott.

Xanthosoma Lindeni, *Moore.* Fol. plant, Ornament, Colombia.

## CYPERACEÆ.

CYPERUS, L.

Cyperus Papyrus, *L.* Perennial, Paper, T. Africa.
*Papyrus Grass.*

## GRAMINEÆ.

ARUNDO, Tourn.

Arundo Donax. Shrub, Ornament, Europe.

ANDROPOGON, L.

Andropogon aciculatus, *R. Br.* Perennial, Grass, Tropics.
*Love Grass.*

Andropogon citratus, *R. Br.* Perennial, Oil, Tropics.
*Lemon Grass.*

Andropogon nardus var citronella. Perennial, Perfumery, Tropics.
*Citronella Grass.*

BAMBUSA, Schrad.

Bambusa vulgaris, *Schrad.* Bamboo, Ornament, India.

Bambusa vulgaris var striata. Bamboo, Ornament, India.

Bambusa nana, *Roxb.* Bamboo, Hedges, Japan.

Bambusa tuldoides, *Munro.* Bamboo, Hedges, China.
*Dwarf Bamboo.*

CYNODON, Rich.

Cynodon dactylon, *Pers.* Perennial, Grass, W. Indies.
*Bermuda Grass.*

DIGITARIA, Heist.

Digitaria didactyla, *Spreng.* Perennial, Grass, Asia and T. Australia.
*Australian Blue Couch.*

DENDROCALAMUS, Ness.

Dendrocalamus giganteus, *Munro.* Bamboo, Ornament, India.
*Giant Bamboo.*

IMPERATA, Cyrill.

Imperata arundinacea, *Cyrill.* Perennial, Asia and T. Africa.

*Lalang.*

ORYZA, L.

Oryza sativa, *L.* Annual, Edible Seed, T. Asia.
*Rice.*

PANICUM, L.

Panicum maximum, *Jacq.* Perennial, Grass, T. America.
*Guinea Grass.*

Panicum muticum, *Forsk.* Perennial, Grass, T. America.
*Mauritius Grass.*

SACCHARUM, L.

Saccharum officinarum, *L.* Perennial, Sugar, Tropics.
*Sugar Cane.*

ZEA, L.

Zea mays, *L.* Annual, Edible Fruit, Mexico.

Zea mays var variegata.
*Indian Corn.*

## FILICES.

ADIANTUM, L.

Adiantum cuneatum, *L. and F.* Trop. America.

Adiantum tenerum, *Sw.*

Adiantum var Farleyense. T. America.
*Species and garden forms.*

ASPIDIUM, Sw.

Aspidium angulatum, *Smith.* Malaya.

Aspidium species.

ASPLENIUM, L.

Asplenium species.

DAVALLIA, Smith.

Davallia species.

GLEICHENIA, Smith.

Gleichenia linearis, *Burn.* Tropics.

NEPHROLEPIS, Schott.

Nephrolepis exaltata, *L.* World.

Nephrolepis exaltata var cristata.

PLATYCERIUM, Desv.

Platycerium biforme, *Bl.* Malaya.

PTERIS, L.

Pteris aquilina, *L.* World.
*The Bracken.*

## LYCOPODIACEAE.

SELAGINELLA, Spring.

Selaginella Wallichii, *Spring.* T. Asia.

## FEDERATED MALAY STATES.

*Comparative Statement of Cultivated Rubber Exported, with Value, and Duty Collected Thereon, During the Years 1915 and 1914.*

| Destination. | Exported during June, 1915. | Previously. | Total export during the year. | Export during similar period of previous year. | Increase. | Decrease. | Value of rubber exported, 1915. | Duty collected, 1915, to date. |
|---|---|---|---|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | $ | $ c. |
| Straits Settlements ... | 2,122.97 | 10,406.23 | 12,529.20 | 7,557.09 | 4,972.11 | ... | 24,587,595 | |
| United Kingdom ... | 1,215.45 | 5,016.24 | 6,231.69 | 5,200.56 | 1,031.13 | ... | 12,177,601 | |
| Continent of Europe ... | 3.00 | 5.00 | 8.00 | 640.05 | ... | 632.05 | 15,880 | |
| Ceylon ... ... | 61.48 | 264.81 | 326.29 | 351.92 | ... | 25.63 | 634,553 | |
| Other Countries ... | ... | 95.07 | 95 07 | 100.27 | ... | 5.20 | 181,447 | |
| Total ... | 3,402.90 | 15,787.35 | 19,190.25 | 13,849.89 | 6,003 24 | 662.88 | 37,597,076 | 974,289 35 |

KUALA LUMPUR,
*5th July 1915.*

F. J. WELD,
*Acting Commissioner, Trade and Customs, F.M.S.*

*Comparative Returns of Imports, F. M., S. during the first quarters 1915 and 1914.*

| Articles | How counted. | Selangor. | | Perak. | | Negri Sembilan. | | Pahang. | | 1915 Total. | | 1914 Total. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value |
| | | | $ | | $ | | $ | | $ | | $ | | $ |
| Coconuts | Pikuls | ... | ... | ... | ... | ... | ... | ... | 73 | ... | 73 | ... | 4,154 |
| Copra | ,, | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Coffee | ,, | 3 | 82 | 139½ | 3,288 | 22 | 526 | 56 | 1,727 | 220½ | 5,623 | 337 | 10,214 |
| Padi | ,, | 2,694½ | 7,661 | 7,196 | 20,317 | 527 | 1,586 | 749 | 2,238 | 11,166½ | 31,802 | 48,711 | 106,891 |
| Rice | ,, | 336,945 | 1,582,754 | 358,138 | 1,659,414 | 80,326 | 387,075 | 19,854 | 102,271 | 795,263 | 3,731,514 | 834,347 | 4,211,866 |
| Pepper | ,, | 86¾ | 2,076 | 46½ | 1,229 | 3½ | 626 | ... | ... | 136¾ | 3,931 | 223¼ | 5,578 |
| Sugar | ,, | 17,947½ | 128,699 | 31,186 | 232,586 | 4,117 | 30,391 | 1,319 | 12,162 | 54,119½ | 403,838 | 60,360$\frac{19}{20}$ | 366,715 |
| Tapioca | ,, | 455½ | 1,930 | 1,146½ | 71,555 | 98 | 1,342 | ... | ... | 1,700 | 20,827 | 1,940⅕ | 16,897 |
| Gambier | ,, | 53$\frac{6}{4}$ | 750 | 97 | 1,712 | 44 | 263 | 27 | 304 | 221¾ | 3,039 | 202 | 2,720 |

*Comparative Returns of Exports, F. M. S., during the first quarters 1915 and 1914.*

| Articles. | How counted | Selangor. | | Perak. | | Negri Sembilan. | | Pahang. | | 1915 Total. | | 1914 Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value |
| | | | $ | | $ | | $ | | $ | | $ | | $ |
| Coconuts | Pikuls | ... | ... | ... | 10 | ... | 645 | ... | 20 | ... | 675 | ... | 491 |
| Copra | ,, | 10,783½ | 91,080 | 39,665 | 331,985 | 456 | 3,812 | 513½ | 4,314 | 51,418 | 431,191 | 48,721 | 601,687 |
| Coffee | ,, | 3,149½ | 78,505 | 76 | 1,610 | ... | ... | ... | ... | 3,225½ | 80,115 | 2,824½ | 101,769 |
| Padi | ,, | ... | ... | 54,001 | 110,673 | 4 | 12 | ... | ... | 54,005 | 110,685 | 63,916 | 135,791 |
| Rice | ,, | ... | ... | 46,848 | 207,672 | ... | ... | ... | ... | 46,848 | 207,672 | 46,029 | 204,260 |
| Pepper | ,, | 35 | 596 | ... | ... | 9 | 192 | ... | ... | 44 | 788 | 101½ | 2,087 |
| Sugar | ,, | ... | 4 | ... | 33 | ... | ... | ... | ... | ... | 37 | 19 | 130 |
| Tapioca | ,, | ... | ... | 2,098 | 3,183 | 5,278 | 23,801 | 2,311 | 12,710 | 9,687 | 39,694 | 11,960 | 48,173 |
| Gambier | ,, | 425 | 2,764 | ... | ... | 1,865 | 18,429 | ... | ... | 2,290 | 21,193 | 2,546 | 21,191 |

*Abstract of Meteorological Readings in the various Districts of Malaya for the month of June, 1915.*

| DISTRICT. | Mean Barometrical Pressure at 32° Fah. | Maximum in Sun. | TEMPERATURE. | | | | HYGROMETER. | | | | Prevailing Direction of Winds. | Total Rainfall. | Greatest Rainfall during 24 hours. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean Dry Bulb. | Maximum. | Minimum. | Range | Mean Wet Bulb. | Vapour Tension. | Dew Point. | Humidity. | | | |
| Kelantan, Kota Bahru ... | ... | 133.8 | 84.5 | 92 43 | 75.63 | 16 80 | 79.8 | .918 | 76.7 | 77% | ... | 3.13 | 0.81 |
| Pahang, Kuala Lipis ... | ... | ... | 82.5 | 91 5 | 77.1 | 14.4 | 76.7 | ... | ... | ... | ... | 14.81 | 2.70 |
| Johore, Johore Bahru ... | ... | ... | ... | 89.97 | 74.90 | 15.07 | ... | ... | ... | ... | ... | 9.76 | ... |
| Singapore, Kandang Kerbau | 29.758 | 158.0 | 85.1 | 90.7 | 75.6 | 15.1 | 79.8 | .939 | ... | 78. | ... | 6.47 | 2.25 |
| Malacca, Durian Daun ... | ... | ... | ... | ... | .... | ... | ... | ... | ... | ... | ... | ... | ... |
| Negri Sembilan, Seremban | .. | 153.9 | 80.9 | 89.3 | 73.2 | 16.1 | 77.6 | .879 | 76.1 | 83.2 | N.W. | 14.45 | 3.53 |
| ,, Kuala Pilah ... | ... | 156.0 | 82.4 | 93.2 | 73.3 | 19.9 | 80.1 | .978 | 77.0 | 88.7 | ... | 6.49 | 1.50 |
| ,, Port Dickson | ... | 132.7 | 84.3 | 90.5 | 75.3 | 15.2 | 79.0 | .889 | 75.6 | 75.6 | ... | 8.77 | 2.13 |
| Selangor, Kuala Lumpur ... | 29.839 | 143.8 | 81.5 | 90.8 | 77.6 | 13.2 | 78.6 | .923 | 76.7 | 85. | S.W. | 7.85 | 2.15 |
| ,, Klang ... | ... | ... | 83.1 | 88.3 | 76.5 | 11.8 | 78.3 | ... | ... | ... | ... | 3.77 | 1.70 |
| ,, Kuala Selangor ... | ... | .. | 89.7 | 75.8 | 13.9 | ... | ... | ... | ... | ... | ... | 4.43 | 1.50 |
| ,, Rawang ... | ... | ... | 91.9 | 75.2 | 16.7 | ... | ... | ... | ... | ... | ... | 11.05 | 3.00 |
| Perak, Telok Anson ... | ... | ... | 82.75 | 93. | 73. | 20. | 78 29 | .898 | ... | 83. | ... | 4.30 | 2.10 |
| ,, Ipoh ... | ... | ... | 83.72 | 95. | 71. | 24. | 78.04 | .893 | ... | 79. | ... | 10.55 | 2.21 |
| ,, Taiping ... | ... | ... | 83.59 | 93. | 72. | 21. | 78.15 | .889 | ... | 79. | ... | 17.45 | 2.93 |
| ,, The Cottage ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 15.78 | 4.36 |
| ,, Parit Buntar ... | ... | ... | 84.12 | 93. | 75. | 18. | 79.09 | .925 | ... | 79. | ... | 10.31 | 2.30 |
| Penang, Georgetown ... | 29.780 | 138.7 | 83.9 | 89.6 | 74.9 | 14.7 | 78.9 | .922 | 75.7 | 79. | ... | 4.84 | 0.64 |
| Kedah, Alor Star ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 10.50 | ... |
| Perlis, Perlis ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 10.99 | ... |